Space Weather Technical Forecast

Issued on Wednesday, 08 November 2023 at 13:07 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight Chance of G1/Minor Geomagnetic Storms at first, but risk declining. Active fluence (1e8 integrated pfu) expected in the coming days. Chance of isolated M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been Low with only C-class flares observed in the last 24 hours, the largest of which came from the AR3483 region, peaking at C6.8 at 08/0848 UTC. There are five numbered and one unnumbered sunspot region on the visible disc. The largest region remains AR3477 which continues to be fairly stable. AR3479 in the northwest has seen development and growth in recent hours, now Dai/Beta-Gamma, and will be monitored closely. AR3483, now Cai/Beta-Gamma, has also seen multiple spots emerge in recent hours with a complex north-south magnetic structure developing on its trailing portion, likely increasing the flare risk from this region in the coming hours/days. The remaining regions remained stable.

A prominence on the northwestern limb was observed lifting off around 08/0700 UTC, with a CME visible on LASCO C2/C3 imagery. This looks to be passing ahead of Earth. No other Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: Solar winds at L1, as observed by DSCOVR and ACE, showed the continued impact of the high speed stream (HSS) associated with CH67/-. Wind speeds were strong, generally between 650-720 km/s. Density was mostly at below average levels, briefly peaking at 11 pccc between 07/2028-2142 UTC. Total interplanetary magnetic field strength (Bt) was generally weak, showing a slow rising trend at first, briefly peaking at 9 nT at 07/2234 UTC, with a slow decline since. The north-south component (Bz) varied weakly between -6 and +8 nT. Phi angle has been predominantly negative (towards the Sun), with just a few brief variations. Geomagnetic activity has been generally Quiet to Unsettled (Kp 2-3).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux has been at background levels over the last 24 hours. GOES16 high energy (greater than 2MeV) electron flux was at moderate levels initially, but briefly rose to high levels between 07/1600-1925 UTC. The associated 24-hour fluence has been below the Active threshold (1e8 integrated pfu), but has risen over the past 12 hrs. The fluence observation at 08/0000 UTC was 4.57e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Generally Low solar activity is expected through the period, but with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: No CMEs currently forecast to reach Earth. Strong wind speeds are likely to continue through Days 1 and 2 (8-9 Nov) due to the ongoing HSS from CH67/-, before a gradual decline through Days 3 and 4 (10-11 Nov).

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Geomagnetic activity expected to be generally Unsettled (Kp3) initially, with a slight chance of further isolated G1/Minor Storm intervals (Kp5) on Days 1 and 2. This risk reducing into the period with activity expected to gradually decline through the following days as the HSS eases to generally Quiet (Kp1-2) levels.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is most likely to remain at background levels. High energy electron flux (greater than 2MeV) is currently at moderate to high levels and expected to remain so through the remainder of the period. The associated 24-hour electron fluence is expected to be just below the Active threshold at first, but with an expectation of exceeding the Active (1e8 integrated pfu) threshold by later Day 1 (8 Nov) and remaining so through the rest of the period, with a slight but increasing chance of reaching 1e9 integrated pfu.

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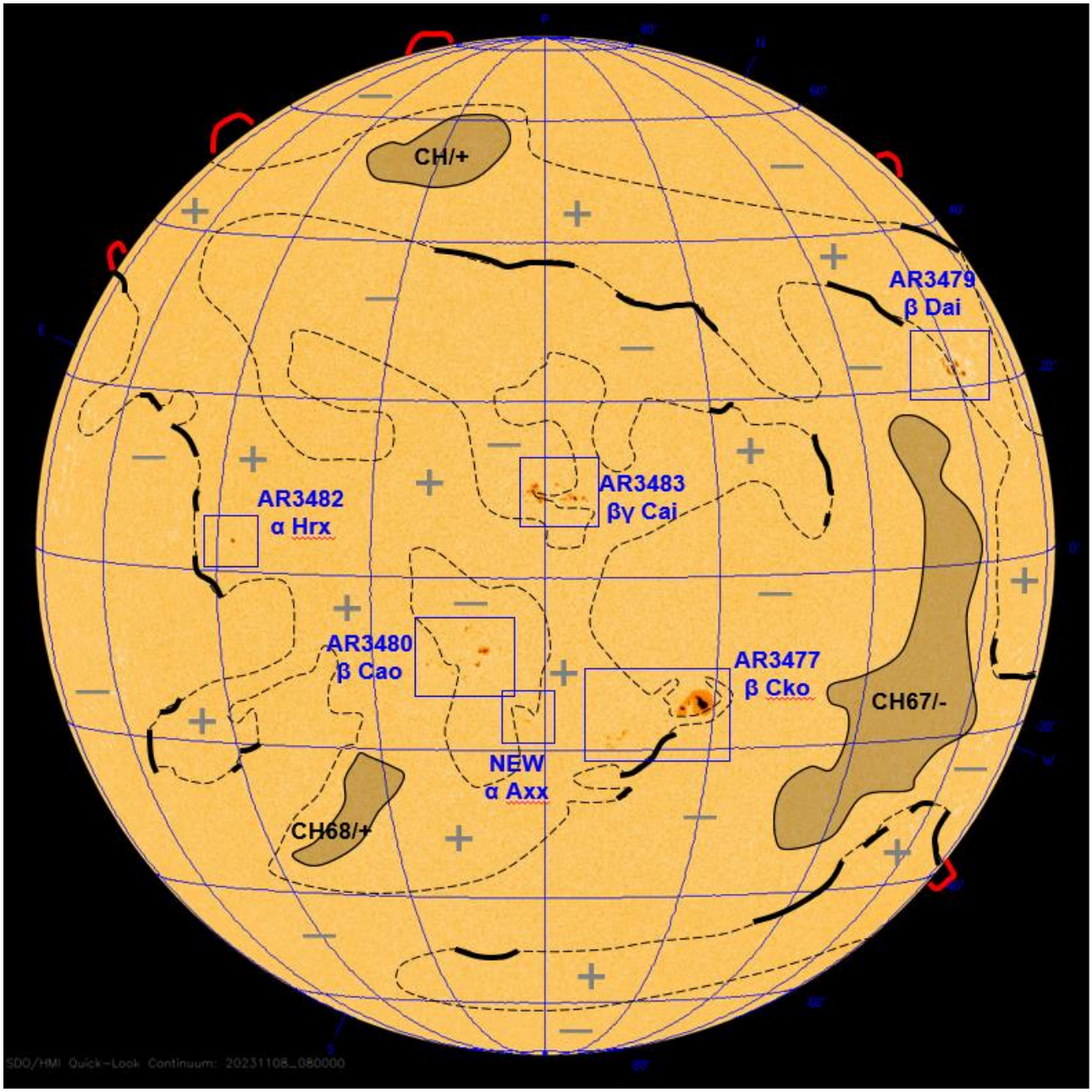
Figure 1. Solar Analysis Valid 08/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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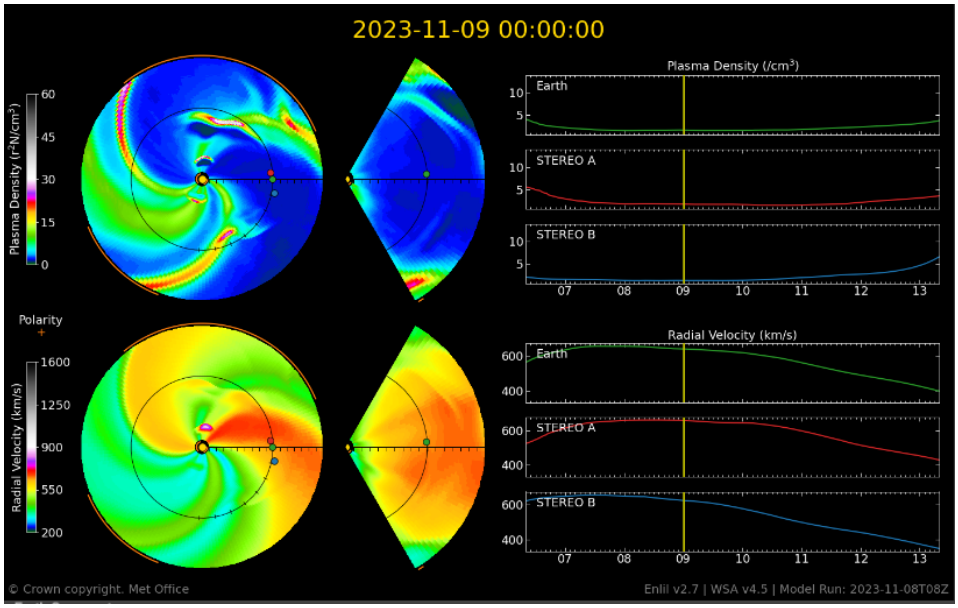
Geomagnetic Storms:
No Earth directed CMEs are currently forecast. A prominence eruption from the NW limb at 08/0700 UTC looks to be missing ahead of Earth.

Solar wind speeds are around 700 km/s, due to the ongoing influence of a HSS from coronal hole CH67/-. Winds are expected to continue at strong levels through Days 1 and 2 (8-9 Nov) before beginning to decline from Day 3 (10 Nov) onwards. Some uncertainty does come in to the forecast regarding this easing due to the shape of CH67, with its southern portion sloping eastwards, which could see stronger solar winds lingering as this portion traverses westward. MOSWOC Enlil modelling currently viewed as providing reasonable guidance for the coming period.

Geomagnetic activity expected to be generally Unsettled initially, with a slight chance of further isolated G1/Minor Storm intervals on Days 1 and 2. This risk reducing into the period with activity expected to gradually decline through the following days as the HSS eases, to generally Quiet levels.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	15	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil model showing continued effct of high speed stream from CH67/-



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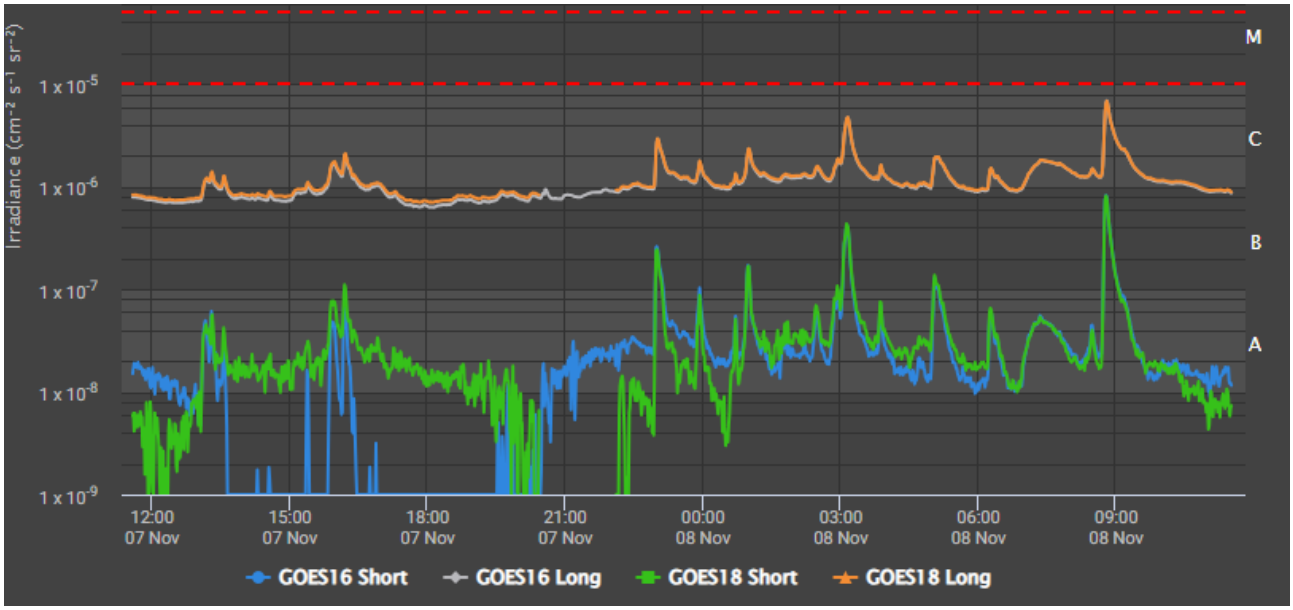
Radio Blackouts - X-Ray Flares:
Activity has been Low with only C-class flares observed in the last 24 hours. AR3483 was responsible for the largest flare, peaking at C6.8 at 08/0848 UTC. Generally low activity expected to continue but with an increased chance of isolated M-Class flares given recent developments in both AR3479 and AR3483, along with the continued threat presented by the larger AR3477 in the southern hemisphere. No further large regions are expected to rotate onto the visible side of the Sun during the period, with only AR3479 due to leave the disk.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES 16 & 18 X-ray flux



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Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at background levels. There is a slight risk of proton enhancement from any larger flares.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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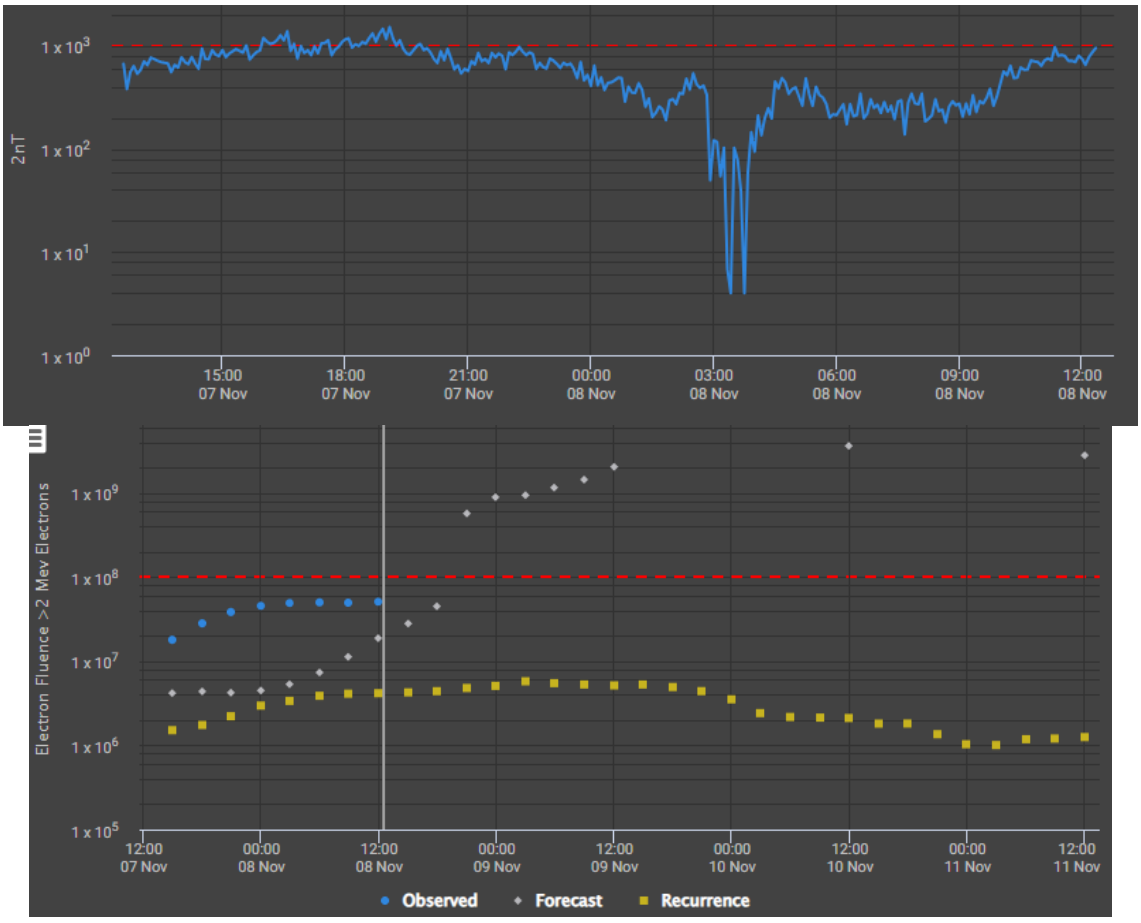
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) has risen to moderate to high levels, following an expected flux increase in the radiation belt after the recent CME and ongoing HSS, with high levels expected to continue as these effects continue to ease.

The associated 24-hour electron fluence is expected to be just below the Active threshold at first, but with an expectation for it to exceed the Active (1e8 integrated pfu) threshold by later Day 1 (8 Nov) and remaining so through the remainder of the period, with a slight but increasing chance of reaching 1e9 integrated pfu. Latest MOSWOC REFM model is viewed as providing good guidance over the coming days.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	80	90	90	90
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	5	15	20

Figure 4: GOES 16 electron flux and REFM showing associated 24-hr electron fluence



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